Northern Adapted Flax Variety Development Project

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Key words: Flax, northern, short season, NuLin, high omega-3, adaptation

Abstract

In 2010, the Northern Adapted Flax Variety Development Project (NAFVD) was launched. This project represents collaboration between the Saskatchewan Flax Development Commission, Viterra, the Alberta Innovates Technology Futures and the British Columbia Grain Producers Association. The breeding objective of the project is to develop new flax varieties better adapted to the northern region of Western Canada. The agronomic objective of this project is to determine best management practices for northern flax production.

Introduction

A strong research partner network has been established for the NAFVD project. The Saskatchewan Flax Growers Commission (Linda Braun, Executive Director) is administering the project. Research partners include Cecil Vera, AAFC Melfort (breeding and agronomy trials); Dr. Khalid Rashid, AAFC Morden (pathology); Clair Langlois, British Columbia Grain Producers Association (breeding trials); Jeff Kostuik and Roger Burak, Manitoba Agriculture, Food and Rural Initiatives (breeding trials); Dr. Jan Slaski, Alberta Innovates Technology Futures (agronomy lead and trials); and Dr. Paul Dribnenki, Viterra (breeding). This partnership includes researchers from all four Western provinces and personnel from the federal government, provincial governments, a producers association, a producer commission and private industry.

A robust network has also been established to support this ambitious project. This funding network includes the Saskatchewan Flax Development Commission (SaskFlax), the Canadian Agricultural Adaptation Program (CAAP), the Government of Saskatchewan's Agriculture Development Fund, the Western Grains Research Foundation, Alberta Innovates Technology Futures, Agri-Food Research and Development Initiative (ARDI) of Manitoba, Manitoba Agriculture, Food and Rural Initiatives (MAFRI), the British Columbia Grain Producers Association and Viterra. Funding is pending from the Alberta Crop Industry Development Fund (ACIDF).

Discussion

Most of Canada's flax production is concentrated in southeast Saskatchewan and southwest Manitoba. Flax is not well adapted to the northern prairies and as a consequence, limited acres are produced in this zone. As flax is one of the latest-maturing traditional crops, the climate in the northern zone significantly increases the risk of having sufficient frost-free days required to mature flax. The northern climate also heightens the challenges of harvest delays and harvest difficulties due to indeterminate growth (reflowering), late maturity and stems that remain green long after bolls are ripe.

80% of Saskatchewan's flax acreage is grown in southeastern corner of the province. The average yield of flax in the southeastern corner of Saskatchewan (Crop Districts 1A, 1B, 2A, 2B, 3AN, 3ASW, 5A and 6 A) was 20.4 bushels/acre in 2008 (Saskatchewan Government Statistics). The average yield of canola in this region was 24.0 bushes per acre. The northern grain belt of Saskatchewan (Crop Districts 5B, 7B, 8A, 9A and 9B) had an average flax yield of 24.0 bushels per acre (18% higher than for the southeastern corner). In these same two production zones, canola had an average yield of 28.8 bushels per acre in southeastern Saskatchewan and 33.8 bushels per acre in the northern zone. This northern yield advantages amounts to 117% for canola and 118% for flax.

In spite of similar northern yield advantages between canola and flax, 53% of Saskatchewan's canola acreage and only 12% of Saskatchewan's flax acreage is in this northern zone. This corroborates the premise that flax is not well adapted to the northern grain belt of western Canada and that this severely limits production in this zone.

The opportunity is that flax grown in a cooler climate has higher yield potential, higher oil content, higher levels of omega-3 fatty acids and less undesirable saturated fats. As well, developing a second oilseed crop adapted to the northern grain belt is part of a long-term strategy to benefit producers and agriculture in general. Currently, the only oilseed crop adapted to the north is canola and a number of diseases and pests continue to threaten this crop (such as blackleg and clubroot). Flax is a high value crop that is unrelated to canola and immune to many pests and diseases of canola.

Flax seed grown in the north has enhanced oil content over that grown in the southern prairies. A 2009 Contract Registration test included a southern and northern site; NuLin^{R} 50 and CDC Bethune. At Lake Lenore (northern site), the omega-3 content for NuLin^{R} 50 and CDC Bethune was 72.6% and 59.9%, respectively. At Regina, the omega-3 content for NuLin^{R} 50 and CDC Bethune was 68.8% and 56.1%, respectively. Total saturated fatty acids were approximately 0.5 points lower at Lake Lenore versus Regina.

Three northern traits have been identified that would enhance producer acceptability of flax in the northern prairies. Enhancement of these traits are the major breeding objectives of NAFVD project.

The first northern trait is tolerance to seeding in cold soils. In order to reduce harvest challenges and to increase flax yield, flax varieties need greater cold soil tolerances. This would encourage earlier seeding, which would allow for greater exploitation of the complete growing season and as a consequence higher yield potential. This would also allow flax to be grown further north. To address the cold soil tolerance objective, the Viterra flax nursery (located in Vegreville, Alberta), is sown as early as practical. In 2010, seeding commenced on May 8th and was completed on May 13th. Six frost events occurred after seeding commenced; May 8th -3.5^{o}C, May 9th -3.0^{o}C, May 10th -4.0^{o}C, May 11th -1.3^{o}C, May 12th -0.8^{o}C and May 26th -0.9^{o}C. Soil temperature was cool (5^{o}C). By seeding as early as practical, selection pressure is place on germination and emergence in cold soils. Strains that result in good emergence are selected in preference to strains that produce poor stands. This trait is assessed in full plots by taking early vigour notes; tolerance strains having good stands and better seedling vigour than CDC Bethune and susceptible strains resulting in poor stands and seeding vigour.

The second northern trait is determinate growth habit. Some flax varieties are indeterminate. These varieties are susceptible to reflower under moist autumn conditions. Reflowering results in plants with both ripe bolls and new flowers/green bolls, thus delaying harvest. Indeterminate growth habit is regularly expressed at our Vegreville nursery. This provides annual selection pressure on the northern germplasm and as a consequence, strains are selected that have a determinate growth habit.

The third northern trait is better synchronicity between boll and stem ripening. Currently, some varieties under cool, wet harvest conditions can experience up to two weeks delay from boll ripening to stem ripening. This causes significant harvest delays which results in more challenging harvests caused by deteriorating harvest weather conditions. Germplasm has been developed in the Viterra nursery that has better synchronicity between boll and stem ripening. The Vegreville location consistently expresses this trait and allows for identification and selection of flax lines with better stem ripening characteristics. Besides allowing for earlier harvest, more synchronous stem/boll ripening also allows for more opportunity for field retting of the flax straw and as such enhances the suitability of such varieties for the bast fibre processing.

These three northern traits are to be transferred into a suite of varieties with various maturity options. Germplasm has been identified that is up to 21 days earlier to physiological maturity than CDC Bethune. This germplasm was developed, in part, by hybridizing early maturing accessions from the Plant Gene Resources Centre (Saskatoon) and Viterra germplasm. The objective is to develop varieties with northern traits that would range from two weeks earlier to mature than CDC Bethune to the maturity rating of CDC Bethune. This would result in full exploitation of yield throughout the agricultural regions of western Canada; from northern to southern zones.

Our most advanced germplasm of the NAFVD project was F5 lines in Viterra's 2010 nursery. 187 lines of 989 lines evaluated were selected for improvements to all three northern traits. 66 of these selected lines were NuLin^{R} yellow-seeded lines, were on average 6.8 days earlier to physiologic maturity than CDC Bethune, were on average

98.8% yield of CDC Bethune and had a yield range of 90% to 173% of CDC Bethune. 76 of these selected lines were NuLin^{R} brown-seeded lines, were on average 7.5 days earlier to physiologic maturity than CDC Bethune, were on average 101.3% yield of CDC Bethune and had a yield range of 90% to 139% of CDC Bethune. 45 of these selected lines were tradition brown-seeded linseed lines, were on average 8.1 days earlier to physiologic maturity than CDC Bethune, were on average 101.2% yield of CDC Bethune and had a yield range of 90% to 125% of CDC Bethune. All 187 lines were sent to Dr. Khalid Rashid, AAFC Morden, for rust evaluation. A maximum of 138 of these 187 lines will be selected for advancement to 2011 pre Co-op tests at seven locations throughout western Canada. From this, a number of Flax Co-op candidates will be selected for advancement into the 2012 Flax Co-op test. Support for registration of the first northern adapted flax varieties could be requested as early as February 2014.

Conclusions

The NAFVD is a ten year project, split into two-five phases. It is anticipated that the first northern adapted flax varieties will be supported for registration by the end of the first five year phase. The second five year phase will focus on enhancing the northern traits into higher yielding varieties.

The NAFVD project represents an important breeding and agronomy effort aimed at developing better adapted flax varieties for the northern prairies of Western Canada. Agronomic best management practices will also be identified that will all farmers to optimize yield and result harvest challenges. These northern adapted varieties should also benefit southern flax growers and allow for higher yield potential and less harvest challenges for them as well.